INTERFACE FOR CONTROLLING A GRAPHICAL IMAGE

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority from co-pending U.S. Provisional Patent Application Nos. 60/197,656 and 60/197,657, both of which were filed on Apr. 17, 2000 and both of which are incorporated herein by reference in their entireties.

BACKGROUND

[0002] The present invention relates to interfacing a user with a computer, such as a computer for performing a virtual reality simulation.

[0003] Users interface with electronic and mechanical devices in a variety of applications, and the need for a more natural, easy-to-use, and informative interface is a constant concern. In the context of the present invention, a user interfaces with computer devices for a variety of applications. One such application is interacting with computer-generated environments, such as virtual reality environments, including games, surgical simulations, and application programs. Computer input devices such as mice and trackballs are often used to control a cursor within a graphical environment and provide input in these applications.

[0004] In some interface devices, force feedback and/or tactile feedback is also provided to the user, collectively known herein as "haptic feedback." For example, haptic versions of joysticks, mice, gamepads, steering wheels, or other types of devices can output forces to the user based on events or interactions occurring within the graphical environment, such as in a game or other application program. In a virtual reality simulation, it is often desirable to graphically represent a user or a portion of the user in the graphical environment and to allow the user to realistically interact with the graphical environment.

SUMMARY

[0005] To overcome the deficiencies of the prior art, it is desirable to provide an interface device that improves the interaction of a user with a graphical environment. It is further desirable to provide an interface device that applies realistic haptic sensations to a user. In addition, it is desirable to provide an easily implementable and inexpensive interface device.

[0006] The present invention satisfies these needs. In one aspect of the invention, an interface device for interfacing a user with a computer, the computer running an application program and generating a graphical image and a graphical object, comprises a user manipulatable object in communication with the computer, a sensor to detect a manipulation of the object, the sensor providing a signal to the computer to control the graphical image, and an actuator adapted to provide a haptic sensation to the palm of the user in relation to an interaction between the graphical image and the graphical object, the actuator comprising a member that is deformable to provide the haptic sensation.

[0007] In another aspect of the invention, an actuator for providing a haptic sensation to a user interfacing with a computer running an application program comprises a deformable member having a first end, a second end, and an intermediate portion, and a tendon capable of displacing the first end relative to the second end in response to the computer to cause the intermediate portion to contact the user and thereby provide a haptic sensation to the user.

[0008] In another aspect of the invention, a mouse for interfacing a user with a computer generating a graphical environment comprising a graphical hand comprises a housing, a position detector to detect a position of the mouse, the position detector capable of providing a first position signal to the computer to control the position of the graphical hand in the graphical environment, and a finger position detector to detect a position of a finger of the user, the finger position detector capable of providing a second position signal to the computer to control a graphical finger on the graphical hand in relation to the position of the finger of the user.

[0009] In another aspect of the invention, a mouse for interfacing a user with a computer comprises a housing, a position detector to detect a position of the mouse, a member adapted to contact a finger of the user, the member being capable of being moved by the finger in two directions, and a member position detector to detect a position of the member.

[0010] In another aspect of the invention, a method for interfacing a user with a computer running an application program, the computer generating a graphical environment comprising a graphical hand, comprises providing a mouse in communication with the computer, detecting a position of the mouse, controlling the position of the graphical hand in relation to the detected position of the mouse, and controlling a shape of the graphical hand in relation to an amount of manipulation of the mouse.

DRAWINGS

[0011] These features, aspects, and advantages of the present invention will become better understood with regard to the following description, appended claims, and accompanying drawings which illustrate exemplary features of the invention. However, it is to be understood that each of the features can be used in the invention in general, not merely in the context of the particular drawings, and the invention includes any combination of these features, where:

[0012] **FIG. 1** is a schematic diagram of a simulation system according to the present invention;

[0013] **FIG. 2** is a schematic diagram of a simulation system comprising an instrumented glove according to the invention;

[0014] **FIG. 3** is a schematic diagram of a simulation system comprising an instrumented glove with joint angle sensors according to the invention;

[0015] **FIGS. 4A through 4C** are a schematic side views of the actuation of a palm forcing mechanism according to the invention;

[0016] **FIGS. 5A and 5B** are schematic exploded and assembled views, respectively, of a version of a palm forcing mechanism according to the invention;

[0017] **FIGS. 6A through 6H** are schematic side views of embodiments of palm forcing mechanisms according to the invention;